DOCUMENT RESUME

ED 279 464 RC 016 136

AUTHOR Doeksen, Gerald A.; Peterson, Janet
TITLE Critical Issues in the Delivery of Local Government Services in Rural America.
INSTITUTION Economic Research Service (DOA), Washington, DC. Agriculture and Rural Economics Div.
REPORT NO AGES860917
PUB DATE Jan 87
NOTE 28p.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Budgeting; Change; *Community Services; Crime Prevention; *Delivery Systems; Elementary Secondary Education; Fire Protection; Hospitals; Literature Reviews; *Local Government; *Local Issues; *Research Needs; *Rural Areas; Rural Development; Rural Education; Solid Wastes; Water Treatment

ABSTRACT

Technological changes, an increase in demand for quality community services, and environmental controls have created conditions of continual change in the delivery of rural services. This report summarizes economic theory on community service delivery, reviews economic literature on specific community services, and identifies research gaps and public policy issues. Specific community service topics include education, rural water systems, crime and police protection, fire protection, hospitals, and solid waste. For each topic, current literature on production functions and economies of size is reviewed, revealing many research gaps. Research issues related to production functions and cost curves which are discussed include the need for data, output and inputs, technology, regulations and policy, and new theory. Research priorities identified are: maintaining current community service facility budgets and expanding production function research to include a current data base, further clarification between inputs and outputs, evaluation of alternative proposed policies, and new theories for delivery of community services. Conclusions suggest research results need to be transferred to extension agencies in a form easily understood and usable and reports to congressional committees must clearly state effects of the policy and be based on sound economic principles. The 79 references cited in the literature review are listed. (NEC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

RC

United States
Department of
Agriculture

Economic
Research
Service

Agriculture
and Rural
Economics
Division

ED279464

Critical Issues in the Delivery of Local Government Services in Rural America

Gerald A. Doeksen
Janet Peterson

RC016136

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

BEST COPY AVAILABLE

CRITICAL ISSUES IN THE DELIVERY OF LOCAL GOVERNMENT SERVICES IN RURAL AMERICA. By Gerald A. Doeksen and Janet Peterson, Agriculture and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture, ERS Staff Report AGES860917.

ABSTRACT

Technological changes, an increase in demand for quality community services, and environmental controls have created conditions of continual change in the delivery of rural services. This report summarizes economic theory on community services, reviews literature, and identifies research issues. Current research on budgets for community services and facilities and on the production, or delivery, function are identified as high-priority issues. Also, the crucial topic of extending research findings to the final user is discussed.

Keywords: Community services, rural development, education, rural water, rural crime prevention, fire, hospitals, solid waste, budgeting production functions.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the comments of Dr. Marlys K. Nelson.

CONTENTS

	Page
SUMMARY	iv
INTRODUCTION	1
REVIEW OF ECONOMIC THEORY	2
Demand	2
Supply	2
REVIEW OF THE LITERATURE	3
Education	3
Rural Water Systems	5
Crime and Police Protection	7
Fire Protection	9
Hospitals	9
Solid Waste	11
RESEARCH GAPS AND PUBLIC POLICY ISSUES	11
Budgeting	12
Production Functions	13
Extension	16
CONCLUSIONS	17
REFERENCES	19

* * * *

SUMMARY

Technological changes, an increase in demand for quality community services, and environmental controls have created conditions for continual change in the delivery of rural services. Economists and other social scientists have completed useful research and need to be encouraged to continue efforts in priority areas. The objective of this paper is to review research on community services, identify needed research, and encourage proper dissemination of research.

The report briefly examines economic theory of community services in relation to research problems and gaps in the literature. Specific community service topics include education, water, crime and police protection, fire, hospitals, and solid waste. For each topic, the literature on production functions and economies of size is reviewed. The review reveals many research gaps.

Some of the research priorities identified are:

- .Maintain current community service facility budgets; and
- .Expand production function research to include:
  - -a current data base;
  - -further clarification between inputs and outputs;
  - -evaluation of alternative proposed policies; and
  - -new theories for delivery of community services.

Research results need to be transferred to extension and other agencies in a form easily understood and useable. Reports to congressional committees and other groups must clearly state the effects of the policy and be based on sound economic principles. Less technical reports are needed for other purposes. The bottom line is that there is a rural clientele which needs our best research and extension efforts. The payoff will be a contribution to the quality of rural life.

Critical Issues in the Delivery of Local Government Services in Rural America

Gerald A. Doeksen
Janet Peterson

INTRODUCTION

Technological changes, increases in demand for quality community services, and emergence of environmental controls have created conditions of continual change in the delivery of rural services. Traditional methods of delivering community services have not kept pace with the increased public demand and the dynamic changes taking place in rural economies. The legislators and rural development program administrators over the past several years have recognized that providing community services to rural areas is a critical ingredient to the quality of life in rural America. For example, the Rural Development Act of 1972 (72) contained provisions relating to water, sewer, solid waste, and other essential community services.[1/] The Carter administration (70) had as one of its major national rural development goals to "improve the access of rural residents to adequate housing and essential community facilities and services."

The current administration has proposed funding decreases for many community service programs. As Federal dollars are reduced, local community leaders will need to seek out efficient and effective delivery systems for community services. That will include adopting new technologies, creating innovative funding mechanisms, and familiarizing themselves with alternative delivery systems and their implications.

Economists, sociologists, political scientists, geographers, and other professionals can make important contributions by assisting local leaders as they allocate scarce resources for community services. David J. Pyle states:

> What we have seen from our selective examination of the application of cost-benefit and cost-effectiveness techniques is that economics and economists have an important role to play in the evaluation of police expenditures. It has been found in all of the examples we have considered that existing allocations of resources could have been improved upon by the use of these economic tools. Rarely was it found that common sense led to an economically efficient allocation of resources.(56)

Although the above quotation applies to economists, all disciplines have important contributions to make in community service delivery.

---

*Gerald A. Doeksen is regents professor, Department of Agricultural Economics, Oklahoma State University, and Janet Peterson is research assistant, Department of Agricultural Economics, Oklahoma State University.

1/ Underscored numbers in parentheses cite sources listed in the References.

The overall objective of this report is to review research on community services, identify needed research, and identify policy issues. More specifically, we aim to:

- o briefly review economic theory on community service delivery;
- o review economic literature on specific community services; and
- o identify research gaps and public policy issues.

REVIEW OF ECONOMIC THEORY

Rural community services exhibit some characteristics of a public good. A pure public good according to Samuelson (62) is characterized by (1) jointness or joint consumption and (2) exclusivity. Joint consumption implies that consumption of the good by one person does not preclude its consumption by others. The exclusion principle implies that it is difficult to exclude anyone from the benefits of the good if one does not wish to pay. Hirsch (36) states that few public services exist as a pure public good. Ostrom and Ostrom (54) suggest that there is a continuum of the extremes of pure public goods and pure private goods. If, for example, the market operates to guide production and distribution of a good, that good is near the "private goods" end of the continuum; where the market is not operating efficiently to produce and distribute the good or service, it is near the "public goods" end of the continuum. For goods and services near the public goods end of the continuum, the public relies on the political process to determine the type and extent of supply of the good or community service. The Government attempts to provide a balance between the amount of service provided and the amount consumers require. Hirsch (36) adds that community services are often produced under conditions of declining average costs.

Demand

Demand refers to the behavioral relationship between price and consumption of a good or service. Demand for community services is often difficult to estimate. First, not all community services carry a consumption price. Second, very few community services have output units with well-defined physical conditions. Proxies are often used to measure output or output quality.

Hirsch (34) discusses three ways to measure demand. First, if some price signals are available such as with water and electricity, demand can be estimated directly. Second, estimates of demand can be based on voting behavior. Third, if price signals are extremely weak, benefit-cost analysis can be used. If the analysis is comprehensive, it will show what benefits and costs pertain to various groups. Thus, it can provide decisionmakers with information on who is likely to gain, who is likely to lose, and by how much in each case. Often, however, these studies reveal only what the investigator believes demand ought to be.

Supply

Much of the research effort on delivery of community services has been directed at estimating production functions and cost equations with implications for

economies (or diseconomies) of size. A production function represents the relationship between service outputs resulting from different physical inputs per unit of time, subject to certain constraints.

Output has both quality and quantity dimensions, adding to the problem of estimating a production function. An index will often be used to reflect quality. In addition, technology is often considered fixed and, thus, dropped from the equation. Researchers obtain longrun average cost by adding input factor prices into the production function. Once cost curves are estimated, researchers can use the shape of the longrun average cost curve to indicate the presence of economies or diseconomies of size.

There are reasons to expect economies in the early stages of the curve and diseconomies in the later stages, implying a U-shaped curve (25): (1) increased specialization of labor; (2) greater specialization of managerial skills; (3) use of available large-scale technologies; (4) use of large-scale purchasing and selling; (5) more efficient use of factors of production; (6) greater ability of large organizations to hedge against uncertainties; and (7) better use of byproducts by large organizations. As output increases beyond a certain point, limits to efficient management offset these factors and diseconomies arise.

REVIEW OF THE LITERATURE

A selected review of past research relative to production functions, cost curves, and economies of size for education, water, police, fire, hospitals, and solid waste will be presented next.

Studies on community service budgets will not be presented in our report because they were recently reviewed in earlier papers by Doeksen (19) and Doeksen, Woods, and Lenard (20).

Education

Hirsch (33) made the first indepth analysis of the economies of size of public schools. He sought the determinants of expenditures for public primary and secondary education and their relative importance, including the scope and quality of education. Using multiple regression and correlation techniques, he developed two working models. The first included scope and quality as independent variables while the second excluded these variables in order to estimate coefficients of income elasticity. The models included five main characteristics of the local area: population, sociological composition, physical facilities, economic status (including financial ability to afford education), and government type. The sixth expenditure determinant was per pupil expenditures on public education based on average daily attendance. Hirsch applied this model to school districts in the St. Louis city-county area. He found income elasticities for public education (such as teacher salaries and educational supplies) to be 0.56 and those for instruction (total per pupil current expenditures plus debt retirement) to be 0.43, both inelastic. His results also showed that no significant economies of size in the school districts were realized and suggested that consolidation is unlikely to solve the financial problems of schools. He felt that districts could hire more specialists jointly and thus afford more variety in high school offerings.

As public school districts become larger and more complex, examining the size-cost relationship becomes more difficult. Another study on the relevance of economies of size (Hanson (31)) used descriptive data of two types: school district size measured in average daily attendance (ADA) and unit cost residuals for each district. Residuals adjust current expenditures per pupil for the influence of specific characteristics of the adult population upon expenditure levels. Hanson found economies of size among districts enrolling more than 1,500 pupils. Unit cost residuals were found to decline with increasing district size up to an optimum whose median was about 50,000 ADA. These findings support the hypothesis that a U-shaped cost curve exists between district size and unit costs in public schools.

Another study analyzed the relationship between school size and cost, concentrating on public high school systems and emphasizing individual schools rather than school districts (Riew (59)). Researchers examined senior high schools (both those enrolling grades 9 through 12 and grade 10 through 12) in Wisconsin. Using least-squares multiple regression analysis to approximate the net relationship, researchers' results suggested that adding to enrollment lowers the average operating expenditures per pupil until enrollment reached 1,675, indicating that economies of size for public high schools are very significant. Enrollment of 200 to 500 pupils meant a savings of $95.45 in average per pupil operating expenditures, enrollment of 500 to 1,000 implied a savings of $111.00 per pupil expenditures, and enrollment of 1,000 to 1,675 indicated a savings of $54.67 per pupil. Transportation costs and operational expenditures were excluded.2/

Cohn (12) analyzed production functions and per pupil costs for 377 high school districts in Iowa. Using least-squares multiple regression, he developed models that contained variables which measured quality of education. Instead of using an index of scope and quality as did Hirsch in his 1960 study, Cohn used average daily attendance and the Iowa Tests of Educational Development, an achievement test given to high school students at regular intervals. Results indicated a U-shaped, longrun average cost curve and economies of size. Cohn concluded that consolidation would be beneficial since a larger school spends a smaller amount of resources per student for the same quality of education. This study determined that the optimal school size determined was approximately 1,500 pupils.

In analyzing the net relationship between expenditures per pupil and size of school system, Osburn (53) found that school systems realized economies of size as student enrollment approached 1,500. He found a savings of $47 per pupil in schools with enrollments from 200-2,244 students. This figure is much lower than that found by Riew (59) because Osburn included transportation costs in his analysis. The regression model included information on average daily attendance, expenditures, and other characteristics of the school districts.

2/ Average per pupil operating expenditures are the sum of current expenditures for administration, teacher salaries, other instruction, school operation, and school maintenance. Operational expenditures are outlays for auxiliary services (school lunches, pupil recreation, and health programs) and other minor items.

Rosenberg (61) and Johnson (41) both used current expenditures to determine the average cost curve. Johnson found that minimum per pupil operating costs are achieved when the average daily attandance is 1,426 students.

Ricker and Tyner (58) developed a multiple linear regression model to examine the characteristics of economies of size in Florida public schools. The model assumed consolidation of the counties in the study area based on a criterion of efficiency of in-school costs, excluding transportation and capital improvements. Researchers first developed a relationship between expenditure per pupil and ADA. These results were then used to develop cost coefficients for a linear programing (LP) model. The LP model assigned the study area counties that minimized in-school expenditures. Results showed economies of size were realized when counties consolidated and that savings could be realized through more efficient-sized government units. As the size of the school district increased (in terms of ADA), expenditures per pupil (for in-school costs) could be expected to decrease. Annual savings ran from $600,000 for consolidation involving one and two counties and up to $1,326,000 for combinations of one to five counties.

Watt (74) adopted a model similar to Riew's and Cohn's. He investigated the relationship between school size and average cost of output. Watt's results showed that no economies of size existed for the school sizes considered and that the proportion of pupils financed by local authorities had a strong negative effect on costs. Holland and Baritelle (38) determined the least-cost pattern of allocating students across the nine school districts in Lincoln County, Washington, and concluded that savings achieved from consolidation would be very small due to increased transportation costs. Two studies that examined sparsely populated areas were conducted by White and Tweeten (78) and Holland and Baritelle (38). White and Tweeten found that the district with minimum cost per size ranged from 300 pupils for a low-density school district to 1,075 pupils for a high-density school district. Their major conclusion was that the more sparsely populated areas are less likely to gain from consolidation than the more densely populated areas.

Fox (24) reviewed 30 studies in an attempt to measure the relationship between size of schools or school districts and the cost of education. He concluded that size economies can be realized in public elementary and secondary schools ranging from 300-600 pupils at the elementary level and from 1,400-1,600 pupils at the secondary level. Economies, they found, can also be realized in school district administration in school systems in the same size ranges.

Rural Water Systems

Much of the research on water systems has involved estimating average cost curves where the average cost depends upon a series of factors representing price and quantity of inputs, service conditions such as population and weather, level of technology such as with pumps, and scale of output. Ordinary least-squares regression has been the technique most widely employed in research on economies of size.

Bourcier and Forste (7) estimated cost curves for 10 water systems in New Hampshire and Maine based on accounting data for the period 1955-65. Cost economies were found when water works expanded capacity by adding wells, pumps,

auxiliary equipment, or transmission mains. Results showed diseconomies when capacities were increased by adding to surface supply or using extensive treatment facilities. They concluded that these apparent cost economies resulted from time trends related to costs. They did not indicate whether or not costs were standardized over time.

Cosgrove and Hushak (16) estimated cost functions for public water systems in 79 Ohio cities using 1968 data. Populations for all cities exceeded 5,000. All cost models were estimated by single equation least-squares. Results indicated significant increases in marginal costs. The study also concluded that marginal costs of water flow decline with increasing system size. However, the rate of decline is too small to make the consolidation of water systems feasible unless the size of the consolidated system is several times larger than the individual systems. The costs of producing water for consumption need to be linked to the costs of treating wastewater.

Research by Daugherty and Jansma (18) involved a sample drawn from 246 Pennsylvania water authorities serving a customer base ranging in size from 55 to over 42,000. This study employed cross-sectional data and used stepwise regression to estimate average cost curves. To check for the existence of economies of size, Daugherty and Jansma estimated that the average cost depends on both population and volume of water produced. Results suggested that very slight economies existed when customers served and water sold increased by the same rate. Economies were more apparent for surface water systems than for ground water systems. If water use per customer increased, however, substantial size economies resulted.

Johnson and Hobgood (42) examined 62 rural systems in Louisiana ranging in size from 23 to 686 customers. They used stepwise multiple regression to estimate cost curves for three groups of systems: (1) those serving under 100 customers; (2) those serving 100 to 199 customers; and (3) those serving 200 or more customers. Cost curves were estimated for annual fixed, variable, and total costs. The researchers found constant economies for groups 1 and 3 and no economies of size for group 2. This study was limited by a small sample size, the arbitrary nature of the size divisions, and the use of debt payment as a measure of fixed costs.

In a study of Oklahoma rural water systems, Sloggett and Badger (64) investigated economies of size in a per capita cost approach. They found that for both investment and annual costs, the number of customers served appeared to have no significant effect on costs. As density of customers increased by one customer per mile, however, annual costs per customer decreased by $1.45 for systems on wells and $2.25 for systems purchasing treated water. Since only 8 of the 57 systems had over 500 customers, no conclusion could be drawn with respect to economies of size.

In a study of 82 Oklahoma rural water systems, Goodwin, Doeksen, and Nelson (28) attempted to detect economies of size by system type: purchased water, ground water, and treated water. Upon analyzing the data, enumerators found that average costs did not differ by system type. For purchased, treated water, ground water, and water treatment systems, average annual operating costs were $70.25, $68.01, and $53.24 per hookup, respectively. There was no conclusive evidence to indicate that economies of size existed for the group studied (89 to 1,285 hookups).

Kuehn and others (43) studied rural water systems in Missouri for economies of size. No significant differences were found in capital costs by system type to indicate the presence of economies of size. The researchers noted that there were differences in annual operating costs between ground water and purchased water systems. In addition, they detected statistically significant differences between Ozark and non-Ozark costs. Briefly, average capital and operating costs per hookup were: $52.62 for non-Ozarks ground water (no treatment) systems versus $71.39 for Ozark ground water (no treatment) systems; $77.49 for non-Ozarks ground water (treatment) systems; and $99.05 for systems using purchased treated water. Operating costs per hookup were nearly constant for districts purchasing water and for ground water districts with fewer than 700 customers. No definite conclusions could be drawn on possible economies of size because the sample of 72 contained very few large districts.

A study completed by Romamurthy and Chicoine (60) yielded information on capital costs of rural water systems. They developed cost equations to be used for initial planning and optimization models. Myoung (50) developed an optimal investment model and applied it to rural water systems in Oklahoma. The model derives optimum investment strategies, given water supply prices and other variables. Another recent article by Gessaman (27) concludes that rural water systems funded by Farmers Home Administration are not maintaining accounts for replacing capital equipment and loan repayment. He concludes that many of these systems may not be financially sound.

Results from a study by Bruggink (9) concluded that Government-operated water utilities had lower operating costs than privately operated water utilities. The Bruggink study's findings agree with those of Mann and Mikesell (48) but differ with a study by Crain and Zardkoohi (17). Crain and Zardkoohi allowed for wage-rate differences, but did not control for production, environmental, and regulatory differences.

Crime and Police Protection

In 1959, Hirsch (35) presented one of the earliest studies, using per capita expenditures and population to project per capita expenditures for police protection services. He concluded that economies of size were not present. Schmandt and Stevens (63) concluded in a study performed for the State of Wisconsin that per capita expenditures for police protection correlated with population and service level.

Morris and Tweeten (49) estimated the economic cost of crime in different city sizes adjusting for race, sex, per capita crime rates (C), per capita police number (P), population size, median income levels, age of population, and population density. The model they used employed a simultaneous system where C_t and P_t are jointly determined in the current year, t. They computed the cost, in dollars, of holding the crime rate down to a given level over all sizes of cities. Police numbers are varied by city size so that the crime rate is held constant at a given level over all city sizes. The approach assumes that: crime can be controlled; the cost of controlling crime at levels specified in this study is less than the social cost of allowing it to occur; and the social cost per capita is the same among cities in which the measured crime rate is the same. The model was applied to data from 754 cities ranging from less than 25,000 to over 1 million inhabitants. The results show that the per capita social cost of crime declines slowly with larger cities until a low point is reached in cities with populations ranging from 250,000 to 500,000.

Social costs rise sharply for cities with populations over 1 million. Smaller cities were able to reduce crime rates by increasing police numbers while larger cities did not. According to the study, the most cost-effective, longrun solution to combatting high crime in large cities was shown to employ decentralization policies rather than to increase police rates.

Popp and Sebold (55) investigated the relationship between per capita crime costs (expenditures and losses) and a variety of inter-SMSA (standard metropolitan statistical area) characteristics. The computation included seven types of crime from the FBI uniform crime index: murder and nonnegligent manslaughter, forcible rape, robbery, aggravated assault, burglary, larceny, and auto theft. The results showed that both per capita expenditures and per capita losses were strongly associated with population size. Per capita expenditures on police services were found to decline over a range of populations up to approximately 250,000 and to increase exponentially afterwards. Per capita losses were shown to increase over the relevant range of population sizes. The findings also showed decreasing quasi returns to scale. That is, as SMSA populations become larger, police services were impaired.

Police protection is difficult to measure since police departments provide more than one type of service. Walzer (73) constructed an index of services composed of: the number of offenses cleared; the number of accidents investigated; and the miles traveled by police vehicles. Since these are not corresponding activities, the authors constructed a weighting system where the number of occurrences of each index component was multiplied by the average amount of time for a police officer to investigate a call. The results showed no significant relationship existed between per capita expenditures and population. Since the scale variable plays an important part in accepting or rejecting the economies of size hypothesis, Walzer suggested further research before consolidation can be dismissed as a cost-cutting measure for municipal police protection.

Beaton (5) found that a model using a single-equation least-squares estimation to find determinants of per capita police expenditures for intrastate systems of cities may lead to incorrect results. Three findings support this conclusion: first, the use of cities obtained within a wide population size range will probably produce heteroscedastic residuals; second, significantly different patterns of regression estimates are found for declining rather than growing cities with over 2,000 population. The third finding is a combined result of the first two findings. A series of interactions between size and direction of population change are found to exist.

Most economic relationships are described by smooth, continuous functions. Shifts sometimes occur in these functions, and researchers must identify them. Stinson and Lubov (67) used segmented regression to test for discontinuities or threshold effects in the relationship between population and per capita local expenditures for police protection in Minnesota, North Dakota, and Wisconsin. They identified critical population thresholds where breaks in the structure occurred. In North Dakota, the significant population thresholds were at levels of 900 and 1,900 residents, while, in Wisconsin, thresholds were found at 1,800 and 2,700 residents. Minnesota cities with populations of less than 500 showed a different expenditure function than those with larger populations. These results lead future researchers to question the practice of projecting

smalltown government service expenditures by assuming a continuous, declining relationship between per capita expenditures and population. For police services, this relationship may be neither continuous nor declining. Beaton (5) warned that local planners must use caution when simple functions are assumed.

Hakim, Spiegel, and Weinblatt (29) analyzed property crime and its composition using simultaneous equations. They explained crime and police output (clearance rates as defined as a crime cleared by an arrest) by type and police expenditures. Their data, obtained from 401 urban and nonurban municipalities in New Jersey in 1970, were cross-sectional. The effects of police expenditure on the efficiency of police output were considerable for auto thefts and burglaries while insignificant for larcenies and robberies. Occurrences of violent crimes, larcenies, and robberies showed the strongest effects in determining how much was spent on police.

Fire Protection

Research on fire protection output, costs, and related factors is very limited. Hirsch (35) studied data for 1952 and 1956 from 32 St. Louis-area fire departments to determine factors related to total per capita current expenditures plus debt service for fire protection. He found limited evidence for economies of size in cities with up to a population of 100,000 and substantial diseconomies of size in cities with higher population. Will (77) identified relevant standard units of effort related to professionally determined service levels and service requirements for individual municipal fire departments. When converted to per capita costs, Well found evidence of major economies of size in cities with populations up to 300,000, with limited economies beyond that point. Hitzhusen (37) used data from 143 communities to develop a cost curve. He used an ordinary least-squares method and found evidence of size economies. However, most economies were exhausted for populations greater than 10,000.

Ahlbrandt (1) studied the efficient delivery of fire services by districts in Seattle-King County, Washington. He used ordinary least-squares analysis to estimate per capita expenditures. Decreasing returns to scale for volunteer and paid volunteer departments and constant returns to scale for fully paid departments were found. It was further demonstrated that a private company could provide fire protection services for 47 percent less than a public provider.

Hospitals

Some of the difficulties in estimating production and cost functions for hospitals result from the multiproduct nature of the service output. Alchian (2) and Hushleifer (39) provided theoretical justifications for an L-shaped, longrun average cost curve. Finkler (23) argued that the same diseconomies found in empirical studies were misleading, reflecting that large hospitals used highly sophisticated and expensive equipment inefficiently. In his study of hospital costs, Cohen (14) examined two aspects of cost variation with respect to hospital size among general, "short-term" hospitals. The first was salary and wage differentials caused by factors other than hospital size. He found that cost differentials inflate the costs of hospitals in urban areas relative to hospitals in nonurbanized areas. The second was the use of adult

and pediatric patient days as a measure of hospital output. Adjustments had to be made for auxiliary services, which were very different for hospitals of varying sizes. Without these adjustments, measures of cost comparisons inflated the costs of larger hospitals relative to smaller hospitals. Results showed that hospitals ranging between 150 and 350 beds were most efficient in delivering ordinary patient care. Although larger hospitals were needed for specialized services, they did not appear to be most efficient for "routine" services. On an annual basis, marginal costs per patient per day ranged between $21.50 and $22.00 for a 200-bed hospital.

A hospital is a multiproduct firm and, therefore, estimating its cost function is difficult compared with the quality of each of the services it provides. Lave and Lave (46) developed two procedures for estimating hospital cost functions, the first having two stages. In stage one, they estimated a relation between average cost, utilization rate, size, and time for each hospital. In stage two, they searched for the causes of variation in the estimated parameters among hospitals. The assumption underlying the second was that all hospitals had the same cost function. The data were pooled and used in a cross-section, time-series analysis to estimate that cost function. Results suggested an L-shaped, shortrun average cost curve with marginal cost between 40 and 65 percent of average cost. The results also indicated that if economies of scale existed, they were very weak.

Lave, Lave, and Silverman (45) used three procedures to estimate cross-section cost for hospital inpatient care: factor analysis (principal component analysis), cluster analysis, and a technique that reduced the number of explanatory variables by aggregating variables with similar estimated marginal costs. In this third procedure, hospital inpatient costs consisted of five variables: (1) type of case treated, (2) complexity of case treated given case type, (3) quality of care rendered by case type, (4) hospital institutional characteristics, and (5) utilization of the hospital's capacity. Results showed that the marginal cost was approximately 70 percent of average cost and that no economies of size existed within the size range of the data. Also, advanced teaching hospitals and hospitals located in metropolitan areas had higher costs, as did hospitals performing complex surgery and treating unusual or difficult cases.

Friedman and Pauly (26) derived and tested cost functions for hospitals observed over time when demand was stochastic and unobserved qualitative deterioration in output was possible. Their data consisted of quarterly observations on approximately 800 hospitals for a 5-year period from 1973-78. Results indicated marginal cost of an expected admission to be 98 percent of average cost but only 35 percent for an unexpected admission.

Finch and Christianson (22) analyzed information on hospital costs for health care delivery to rural populations. They estimated average cost functions for rural hospitals using quadratic and logarithmic functional forms. The quadratic specification is consistent with a U-shaped curve and allows estimation of the least-cost number of beds or facility size. The log specification conforms to an L-shaped curve. The data were obtained from 116 hospitals in five Rocky Mountain States (Montana, Idaho, Wyoming, Utah, and Nevada) from 1971-77. Hospitals qualified as "rural" if they were located in a city with fewer than 12,500 residents and in a county with fewer than 16 people per square mile. They used multiple regression analysis to relate average cost

per patient day to a set of explanatory variables specified primarily by economic theory. The results showed that economies of size occurred over the range of hospital sizes observable in rural areas for both quadratic and log cost functions. The hospital size with lowest average cost per patient-day was approximately 113 beds. Cost savings per patient-day could be achieved in rural hospitals by increasing hospital occupancy rates. The occupancy rate with lowest average cost per patient-day was approximately 73 percent.

Steele and Gray (65) carried out a statistical cost analysis of hospitals emphasizing output definition, homogeneity of output and functions, and accurate cost data collection. Results were inconclusive. The authors suggested that models which include the physicians' actions in choosing factor inputs need to be developed.

Solid Waste

Hirsch (32) completed some of the earliest work on the costs of collecting solid waste. He used cross-sectional data for 24 cities and municipalities in the St. Louis area. The data revealed no significant size economies. The results, however, are useful for estimating cost changes as service quality increases or as decisionmakers establish user fees. Young (79) presented an argument for the existence of some size economies and for greater efficiency of the private service provider versus the public provider. Stevens (66) estimated costs of refuse collection in the United States. Data were collected on 340 public and private firms. The results were:

- o It is desirable to ensure an exclusive market area to a single producer;
- o Costs to the household decrease under any market structure up to 20,000 population. Additional savings, although small, occur in market areas of up to 50,000 population; and
- o Costs to households are less with a private collector than with a public system.

Hall and Jones (30) analyzed small solid waste systems in Texas. They concluded that economies of size do exist and that most economies are reached at a population of 10,000. Collins and Downes (15) collected data from 53 small municipalities in Missouri. They used ordinary least-squares analysis to estimate cost curves. Results indicated that economies of size were realized at a service load of up to 100 pickup units and that additional small economies were realized at up to 3,000-4,000 population. The analysis also showed no evidence of systematic cost differences between municipal and contractual systems. It did, however, find diseconomies among private systems.

RESEARCH GAPS AND PUBLIC POLICY ISSUES

For too long, small towns and nonmetro areas have been receiving residual or watered down urban policy (Blakely and Bradshaw (6)). They still are. Rural development researchers and extension workers must take some of the blame for this. Research and extension professionals have not always provided the information to the right people at the right time, which leads to some crucial questions. Who are the decisionmakers or policymakers who need the research

and information? What information do they need and in what form? For community services, the range of policymakers or decisionmakers is from the town council of a small community to the Office of the President. For example, the town council needs information on how it can provide a specific community service in a straightforward, concise, understandable form. At the other extreme, the Office of the President needs information on such things as the impact of Federal regulations on equity and efficiency of services.

In this report, we aim to provide help on research and extension activities to community service policymakers. We will identify gaps and suggest direction. We will identify some of the many visible problems confronting community service professionals. To formulate the discussion, we will present the ideas under three economic tool concepts: budgeting, production functions, and technology transfer or extension. Budgeting and production functions are interrelated, and, therefore, it is difficult to separate them. However, the usefulness of each to selected policymakers warrants the delineation.

Budgeting

At one end of our user framework is the member of the town council or another town leader requesting community service budgets. A budget is defined as a plan for the future that estimates all items of costs and returns. A complete budget makes it possible to estimate expected net income or loss for alternative plans. The main purpose of budgeting is to compare the profitability of different kinds of organizational arrangements for providing services (Castle, Manning, and Smith (10)). In discussing the budget in regard to decisionmaking, Hirsch (36) states:

> Consistent with the economic approach to public decisionmaking is program budgeting, a planning and management process which applies notions of economic efficiency to public decisionmaking. It involves choice among alternatives in order to achieve the most cost-effective use of resources; involving achievement of the greatest effectiveness for given costs and given effectiveness at minimum costs.

Budgets can be prepared by survey methods or engineering methods. The method chosen to develop the budget is unimportant. What is important is that budget information be developed from the latest data, reflecting current prices and technology.

Budgets resulting from research projects often take on similar forms. Each budget study is completed so that costs and revenues for alternative delivery systems can be estimated. For example, if community leaders are evaluating various methods to provide emergency medical services, the budget should summarize: (1) alternative revenue sources and amounts (for instance, charge per call, ad valorem tax, sales tax, utility charge per household); and (2) costs of alternative emergency medical service delivery systems (for instance, fire station-based, hospital-based, privately subsidized, volunteer). The local leaders will then be able to compare costs and revenues and decide which type of system to use in their community.

Budget studies have been completed for emergency medical service, fire services, clinics, water delivery systems, solid waste disposal, transportation systems for the elderly, wastewater collection and treatment, rental apartments, and mobile home park developments.3/

One weakness of the budgeting process is that budgets need to be updated very frequently because technology and costs constantly change. Thus, policymakers need a strong research base. Tweeten (69) emphasizes this point:

> The extension service plays a vital role in helping communities plan and organize more effectively. Its programs need to be strengthened. Of course, an effective research base is essential for a sound extension effort.

An important question arises as to who should conduct this research. Many land-grant institutions lack sufficient personnel and resources to update community service budgets. Even if each did, it might not be an efficient use of resources for each institution to conduct separate community revenue budget studies. Perhaps leadership in providing budgets for public services should come from a Federal research agency as is now done with agricultural products. Or perhaps the regional rural development centers need to take the lead in coordinating community service budgets on a regional basis. Another possibility is to create a national center. Whatever the answer to this important problem, it is clear that local decisionmakers need budget information.

Production Functions

The importance of research related to production functions continually surfaces. Stocker (68) states:

> The most urgent research needs are those that would advance our understanding of the true economic significance of public services and facilities in production and in enhancing the quality of life. Perhaps most basic is the need for research exploring the relationship between public facilities and public service output, i.e., research on public service production functions.

Paul Barkley (4) also reinforces the need for production function research by stating:

> In economic thought, a rather formidable schism exists between efficiency and equity. It is interesting and essential to note that in the matter of delivering public goods in rural areas, both efficiency problems and equity problems remain stymied because of our lack of knowledge about how factor inputs are transformed into public goods and how these goods themselves are eventually transformed into personal satisfactions. Production functions--even in a very primitive form--are needed if policy is to correctly direct more or fewer resources into rural production.

3/ For a summary of those budget studies completed in Oklahoma, see (19) and for a summary of those in the United States, see (20).

These economists have emphasized the critical need for production function research. Cost curve analysis is closely related to production function research. Some research issues related to production functions and cost curves which may aid policymakers are the need for data, output and inputs, technology, regulations and policy, and new theory.

Need for Data

Both Barkley (4) and Stocker (68) stressed the need for a community facilities data base. In its National Rural Community Facilities Assessment Study (NRCFAS), completed in 1983, the USDA took a big step forward in gathering data on public facilities. Preliminary results are presented by Reid and others (57). The results of the extensive survey are primarily descriptive. The survey was the first of its kind and will provide ample future opportunities for analysis. Since USDA gained experience with this survey, the Department would be a prime candidate for future surveys comparable to the current NRCFAS study. If researchers are going to carry out quality production function research, data need to be available.

Output and Inputs

The production function shows the relationship between output and input. For some community services, research needs to be addressed toward defining output accurately. Output reflects both quality and quantity. Researchers emphasizing this point include Hitzhusen (37) in his study on fire protection, Fox (24) in his research on schools, and Lave and Lave (46) and Cohen (14) in their research on hospitals. Another closely related research issue is the economic feasibility of providing service by a public agency, a contractor, or jointly. For many services, the current research results are unclear. For example, Ahlbrandt (1) concluded that costs for private fire departments are lower than for public providers. Collins and Downes (15) indicated that there was no difference between costs for private contracting of solid waste services and public provision of the service. Bruggink (9) indicated that the government provided water at lower costs. More research is needed before definitive conclusions can be drawn.

More research effort needs to be directed toward estimating economies of size for community services. For some services, such as schools, a large number of research studies have been completed. Fox (24) indicates, however, that:

> The extent and availability of size economies in education is not a settled issue. Theoretical, methodological and data problems qualify all the reported findings. Further work is necessary to resolve these issues, but the research will be repetitious and unproductive unless it deals with and overcomes certain problems.

For many other services, the research results on economies of size are conflicting or less clear. Romamurthy and Chicoine (60) specified the need for research on economies of size relating to water systems, Collins and Downes (15) for solid waste collection systems, and Walzer (73) for crime protection. The need for hospital research is even more critical due to the multiproduct nature of the output and the current change in reimbursement policies. Many rural hospitals are in a serious state of financial adjustment and need help in determining production costs.

Extensive research is needed on the topic of marginal productivity of capital and the substitutability of capital and labor. Rural community service providers are asking questions about how to invest new capital and what associated payoff they will reap, if any. For example, rural emergency medical system managers are asking whether they should provide advanced life support services or invest in first responder systems. Research has not yielded information on the benefits of alternative input investments, whether between capital items or between capital and labor. Hirsch (36) shows the need for more research on crime protection. He states that police departments do not know how to put their resources to best use or where to spend their marginal dollars to maximize their benefits.

Technology

In the production function, technology is often assumed to be fixed. As technology changes, new delivery alternatives develop and community leaders need to be made aware of the alternatives and their benefits and costs. Researchers and extension professionals must stay knowledgeable about all new technologies for each community service. For example, several small rural counties in Oklahoma are contracting with a private firm to develop an incinerator to dispose of their solid waste. The firm is producing and selling electrical power. Thus, the firm's contract with each county is lower than the cost of each county to operate its own landfill. Research is needed to report and evaluate the economic feasibility of new technologies under various conditions.

Regulations and Policy

State and Federal agencies continue to issue rules and regulations and propose policy. Community service researchers must be prepared to evaluate the impacts of rules, regulations, and policies. Much of Federal policy emphasizes urban areas, and the impact on rural areas is not sufficiently addressed. For instance, community development researchers have not quantified the huge contributions that volunteers make to rural areas. As a result, the portion of the revenue-sharing formula that includes community or county spending effort for services does not include volunteers' contributions. Thus, rural areas have received fewer revenue sharing funds than urban areas. In addition, certain other policy issues need to be addressed. For example, how have labor programs based on unemployment statistics discriminated against rural areas with high levels of underemployment? How have FmHA programs, such as community facility loan or industrial loan programs, encouraged urban sprawl or provided equity and efficiency in our Nation's programs?

The range of questions and issues in this area is large. But more important is the ability to evaluate proposed policy before it has been implemented. Community facility researchers need to have the foresight to address community service problems before questions are asked and to be able to act quickly on those unanticipated questions. Congressmen usually do not have the time to wait for results of long-term research projects. Thus, a mechanism must be available to provide these decisionmakers with information and evaluation quickly. If time is short, case studies across the United States may provide some extremely useful information. For instance, if the Environmental Protection Agency (EPA) changes landfill regulations at the Federal level, a

case study of 20 or so randomly selected rural landfills might yield some indication of the cost of implementing that regulation. This information would be useful to national decisionmakers.

New Theory

From the literature review, it is clear that using microeconomic theory may not be the answer. Steele and Gray (65) make this point clear when they state:

> 'Economically rational behaviour' is encapsulated in behavioural theory and models, representing often quite elaborate deductive systems. For any new subject area into which the economist extends his interest, for instance the health sector, there is always the temptation to employ the assumptions and hypotheses nurtured in more established areas, hence the application of the theory of the firm to hospital 'production'. Understandable though this might be, our research leads us to believe that little further advancement can be made on these lines. The pre-emptive role of the physician in choosing factor inputs in ignorance of (or ignoring) relative factor prices might mean that such economic models will fail to capture or fully explain past, present or future actions.
>
> Any cost curves derived may not be true technical cost curves but a reflection of both economic and non-economic criteria. Neither might it be possible, therefore, to explain unit-cost difference between similar units of production solely by the normal economic variables such as those employed here and elsewhere. It might be better if the economist accepted the possibly conflicting maximands of the physician and manager and attempted to model these and the conflict rather than attempt to force hospital production behaviour into existing but perhaps inappropriate economic models.

Concerning police protection, Chapman, Hirsch, and Sonenblum (11) say:

> Microeconomic optimizing models incorporating welfare criteria would be preferred. They should perhaps be next on the research agenda and make further use of our empirical estimates of police output and production functions.

An excellent research effort which used a different approach to the theory of the firm was Stinson and Lubov (67). They used segmented regression to estimate per capita expenditures for police protection. They concluded that for police services, the relationship between per capita expenditures and population was neither continuous nor declining. These results cast serious doubt on some of the past research on economies of scale. Studies of this type need to be strongly encouraged.

Extension

The transfer of research knowledge and new technologies to rural decisionmakers is now more important than ever. Federal budget cuts are forcing rural decisionmakers to operate with fewer dollars and to be very efficient in

allocating scarce funds. If it is to be useful, budget and production function research information must be shared with rural decisionmakers. Thus, it is very important that extension economists work with researchers to develop extension material and, in turn, work with rural community decisionmakers in solving rural problems. The extension economists' services are especially needed in small rural communities since community decisionmakers are often volunteers holding full-time jobs. They do not have the time to analyze problems and seek out alternatives. Nor do their communities have paid personnel to conduct evaluations.

Another important function of extension and related agencies is the transfer of new technology to the rural decisionmakers. The researcher needs to evaluate the economic feasibility of new technologies. The extension professional then needs to convey these technologies to rural decisionmakers. Expensive mistakes can be made if the proper information is not provided. For example, several years ago the community leaders of two rural Oklahoma communities bought expensive incinerators. The salesperson convinced them that the incinerators were the most efficient method of disposing of solid waste and the communities made the large capital investments. After several years, it became obvious that this method was not cost effective and an analysis by extension and other professionals showed that it was much cheaper for the community to operate a landfill. The expensive incinerators are standing idle today.

Community services involving large capital investments are often the ones in which technology is changing the most and for which information needs to be transferred to local decisionmakers. For example, current low-cost wastewater system technologies for small communities and rural areas are now available (U.S. Environmental Protection Agency (71)). This information needs to be made available to the local decisionmakers so that a salesperson does not sell them an expensive system. Another current example is the private sector's push for cogeneration plants. Energy production salespeople claim these are economically feasible for medium-sized communities and counties. Researchers and extension workers must work together to help rural decisionmakers so that mistakes are prevented.

CONCLUSIONS

We undertook an extremely large task in this report. All the issues addressed are in some sense critical. We summarized economic theory on community services, reviewed literature, and identified some research issues. We discussed research issues in terms of end users. We suggest that future research emphasis be placed on the following:

- Current community service facility budgets are needed by local decisionmakers because costs and technologies must be constantly updated.

- Production function research is needed by local, State, and Federal decisionmakers. More specifically:

  - a current data source needs to be maintained;

  - relationships between inputs and outputs needs further clarification;

- alternative technologies need to be evaluated and reported to users;

- alternative policies and rules and their effects need to be analyzed before they are implemented; and

- new theories applicable to community services provision need to be developed.

It is critical that timely research targeted to a specified user be provided in a form easily understood. The research results and information on new technologies need to be transferred by extension and other agencies. Reports to congressional committees and other groups must clearly state the effects of the policy or legislation and be based on sound economic principles. Other users need less technical reports. For example, USDA's periodical Rural Development Perspectives does a good job of presenting research results to rural policymakers.

Clearly, as community facility research and extension professionals already know, there is much more to be done. The future of research in the area of community services provision promises to be exciting and can contribute substantially to the quality of rural life.

REFERENCES

(1) Ahlbrandt, Roger, Jr. "Efficiency in the Provision of Fire Services," Public Choice. Fall 1973, Vol. 16, pp 1-15.

(2) Alchian, A. "Costs and Outputs," The Allocation of Economic Resources. Edited by M. Abramovit. Stanford University Press, Stanford, California, 1959, pp 23-40.

(3) Balkin, Steven, and John F. McDonald. "The Market for Street Crime: An Economic Analysis of Victim-Offender Interaction," Journal of Urban Economics. 1981, Vol. 10, pp 390-405.

(4) Barkley, Paul W. "Public Goods in Rural Areas: Problems, Policies, and Population." Paper presented at the annual meeting of the American Agricultural Economics Association, College Station, Texas, 1974.

(5) Beaton, W. Patrick. "The Determinants of Police Protection Expenditures," National Tax Journal. June 1974, Vol. 27(2), pp 335-349.

(6) Blakely, Edward, and Ted Bradshaw. "Rural America: A New Public Policy Frontier," Agriculture Communities: The Interrelationship of Agriculture, Business, Industry and Government in the Rural Economy. Committee on Agriculture, U.S. House of Representatives, 98th Congress, First Session, Washington, D.C.: U.S. Government Printing Office, 1983.

(7) Bourcier, Donald V., and Robert H. Forste. Economic Analysis of Public Supply in the Piscataqua River Watershed. Durham, New Hampshire: Water Resources Center, March 1967.

(8) Bradford, D. F., R. A. Malt, and W. E. Oates. "The Rising Cost of Local Public Services: Some Evidence and Reflections," National Tax Journal. June 1969, Vol. 22, No. 2.

(9) Bruggink, Thomas H. "Public Versus Regulated Private Enterprise in the Municipal Water Industry: A Comparison of Operating Costs," Quarterly Review of Economics and Business. Spring 1985, Vol. 22, No. 1.

(10) Castle, Emery N., H. Becker Manning, and Frederick J. Smith. Farm Business Management. New York: The MacMillan Company, 1972.

(11) Chapman, Jeffrey I., Werner Z. Hirsch, and Sidney Sonenblum. "Crime Prevention, The Police Production Function, and Budgeting," Public Finance. 1975, Vol. 30(2), pp 197-215.

(12) Cohn, Elchanan. "Economies of Scale of Iowa High School Operations," The Journal of Human Resources. Fall 1968, Vol. 3(4), pp 422-434.

(13) _____, and John Riew. "Cost Functions in Public Schools," The Journal of Human Resources. Summer 1974, Vol. 9(3), pp 408-414.

(14) Cohen, Harold A. "Variations in Cost Among Hospitals of Different Sizes," Southern Economic Journal. January 1967, Vol. 33(3), pp 355-366.

(15) Collins, John N., and Bryan T. Downes. "The Effects of Size on the Provision of Public Services: The Case of Solid Waste Collection in Smaller Cities," Urban Affairs Quarterly. March 1977, Vol. 12(3), pp 333-347.

(16) Cosgrove, Michael H., and Leroy J. Hushak. Costs and Quality of Water in Ohio Cities. Research Bulletin 1052. Ohio Agricultural Research and Development Center, Columbus, Ohio, April 1972.

(17) Crain, Mark W., and Asghar Zardkoohi. "A Test of the Property-Rights Theory of the Firm: Water Utilities in the United States," Journal of Law and Economics. October 1978, Vol. 21, pp 395-407.

(18) Daugherty, Arthur B., and J. Dean Jansma. "Economies of Size Among Municipal Water Authorities in Pennsylvania," Southern Journal of Agricultural Economics. December 1973, Vol. 5, No. 2, pp 1-6.

(19) Doeksen, Gerald A. "Budgeting: The Foundation of Community Service Research and Extension Programs." Paper presented at National Symposium on Local Infrastructure Investment Decisions in Washington, D.C., April 16-18, 1985.

(20) Doeksen, Gerald, Mike Woods, and Vanessa Lenard. "An Overview of Community Service Research and Extension Material in the South and in Selected States." Paper presented at Southern Regional Triannual Community Rural Development Workshop, Birmingham, Alabama, 1983.

(21) Farley, John E., and Mark Hansel. "The Ecological Context of Urban Crime: A Further Exploration," Urban Affairs Quarterly. September 1981, Vol. 17(1), pp 37-54.

(22) Finch, Larry E., and Jon B. Christianson. "Rural Hospital Costs: An Analysis With Policy Implications," Rural Health Reports. September-October 1981, Vol. 96(5), pp 423-433.

(23) Finkler, S. A. "On The Slope of the Hospital Industry Long Run Average Cost Curve," Health Service Research. 1979, No. 14, pp 281-289.

(24) Fox, William F. Relationships Between Size of School Districts and the Cost of Education. TB-1621, Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture, April 1980.

(25) _____, Jerome M. Stam, W. Maureen Godsey, and Susan D. Brown. Economies of Size in Local Government: An Annotated Bibliography. RDRR-9. Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture, April 1979.

(26) Friedman, Bernard, and Mark Pauly. "Cost Functions for a Service Firm with Variable Quality and Stochastic Demand: The Case of Hospitals," The Review of Economics and Statistics. 1981, Vol. 63, pp 620-624.

(27) Gessaman, Paul H. "Operational Performance of the FmHA Rural Water System Program." Paper presented at Vth World Congress on Water Resources, Brussels, Belgium, June 1985.

(28) Goodwin, H. L., Gerald A. Doeksen, and James R. Nelson. Economics of Water Delivery Sytem in Rural Oklahoma. Stillwater, Oklahoma: Oklahoma State Agricultural Experiment Station Bulletin B-745, July 1979.

(29) Hakim, Simon, Uriel Spiegel, and J. Weinblatt. "Substitution, Size Effects, and the Composition of Property Crime," Social Science Quarterly. 1984, Vol. 65(3), pp 719-734.

(30) Hall, Patrick J., and Lonnie L. Jones. "Cost of Solid Waste Management in Rural Texas Communities," Southern Journal of Agricultural Economics. July 1973, Vol. 5, No. 1, pp 115-119.

(31) Hanson, Nels W. "Economy of Scale as a Cost Factor in Financing Public Schools," National Tax Journal. March 1964, Vol. 17(1), pp 92-95.

(32) Hirsch, Werner Z. "Cost Function of An Urban Government Service: Refuse Collection," The Review of Economics and Statistics. February 1965, Vol. 47(1), pp 87-92.

(33) _____. "Determinants of Public Education Expenditures," National Tax Journal. March 1960, Vol. 13(2), pp 29-40.

(34) _____. The Economics of State and Local Government. New York: McGraw-Hill Book Company, 1970.

(35) _____. "Expenditure Implications of Metropolitan Growth and Consolidation," Review of Economics and Statistics. August 1959, XLI, No. 3, pp 232-241.

(36) _____. Urban Economic Analysis. New York: McGraw-Hill Book Company, 1973.

(37) Hitzhusen, Frederick J. "Some Measurement Criteria for Community Service Output and Costs: The Case of Fire Protection in Texas," Southern Journal of Agricultural Economics. July 1973, Vol. 5, No. 1. pp 99-107.

(38) Holland, David W., and John L. Baritelle, "School Consolidation in Sparsely Populated Rural Areas: A Separable Programming Approach," American Journal of Agricultural Economics. 1975, 57(4), pp 567-575.

(39) Hushleifer J. "The Firm's Cost Function: A Successful Reconstruction." Journal of Business. 1962, No. 35.

(40) James, H. Thomas, J. Alan Thomas, and Harold J. Dyck. Wealth, Expenditure, and Decision Making for Education. Stanford: Stanford University Press, 1963, pp 63-100.

(41) Johnson, Gary P. "The Estimation of a Long Run Cost Function for West Virginia Public High Schools." Paper presented at the 57th American Educational Research Association annual meeting, Chicago, Ill., April 1972.

(42) Johnson, R. Bruce, and Walter P. Hobgood, Jr. Cost Analysis of Rural Water Systems in Louisiana. Baton Rouge, Louisiana: Center for Agricultural Services and Development. D.A.E. Research Report No. 483, May 1975.

(43) Kuehn, John A., Michael Fessaloye, Curtis Abraschler, and Bob McGill. Analyzing the Feasibility of Domestic Rural Water Supplies in Missouri with Emphasis on the Ozarks Region. Columbia, Missouri: Agricultural Experiment Station Special Report 239, January 1980.

(44) Lankford, R. Hamilton. "Efficiency and Equity in the Provision of Public Education," The Review of Economics and Statistics. February 1985, Vol. 67(1), pp 70-80.

(45) Lave, Judith R., Lester B. Lave, and Lester P. Silverman. "Hospital Cost Estimation Controlling for Case Mix," Applied Economics. September 1972, Vol. 4(3), pp 165-180.

(46) _____, and Lester B. Lave. "Hospital Cost Functions," American Economic Review. June 1970, Vol. 60(3), pp 378-395.

(47) Lerman, Donald L. "The Economies of Public School Closings," Journal of Urban Economics. November 1984, Vol. 16, No. 3, pp 241-258.

(48) Mann, Patrick, and John Mikesell. "Ownership and Water System Operation," Water Works Bulletin. October 1976.

(49) Morris, Douglas, and Luther Tweeten. "The Cost of Controlling Crime: A Study in Economies of City Life," The Annals of Regional Science. June 1971, Vol. 5(1), pp 33-49.

(50) Myoung, Kwang-Sik. "Application of Mathematical Programming for Optimal Investment, Water Supply and Pricing Decisions for Rural Water Systems in Oklahoma." Ph.D. dissertation, Oklahoma State University, Stillwater, 1982.

(51) Ochs, Jack, and Edgar M. Hoover. "On Exploiting Scale Economies," Journal of Urban Economics. January 1977, Vol. 4(1), pp 30-44.

(52) Office of the President. America's New Beginning: A Programming for Economic Recovery. 1981.

(53) Osburn, Donald D. "Economies of Size Associated with Public High Schools," The Review of Economics and Statistics. February 1970, Vol. 52(1), pp 113-115.

(54) Ostrom, V., and E. Ostrom. "Public Choice: A Different Approach to the Study of Public Administration," Public Administration Review 31. March-April 1971, pp 203-216.

(55) Popp, Dean O., and Frederick D. Sebold. "Quasi Returns-To-Scale in the Provision of Police Service," Public Finance. 1972, Vol. 37(1), pp 46-61.

(56) Pyle, David J. The Economics of Crime and Law Enforcement. New York: St. Martin's Press, 1983.

(57) Reid, J. Norman, et al. "Availability of Selected Public Facilities in Rural Communities: Preliminary Estimates." ERS Staff Report No. AGES840113, Economic Development Division, Economic Research Service, U.S. Department of Agriculture, March 1984.

(58) Ricker, William D., and Fred H. Tyner. "An Analytical Approach to the Consolidation of Counties in North and West Florida Based on Educational Efficiency Criteria," Southern Journal of Economics. July 1972, Vol. 4(1), pp 79-87.

(59) Riew, John. "Economies of Scale in High School Operation," The Review of Economics and Statistics. August 1966, Vol. 48(3), pp 280-287.

(60) Romamurthy, Ganapathi, and David L. Chicoine. "Capital Costs of Rural Water Systems: An Empirical Approach," Water Resources Bulletin. April 1984, pp 255-260.

(61) Rosenberg, Neal E. "School Size as a Factor of School Expenditure," Journal of Secondary Education. March 1970, Vol. 45(3), pp 135-142.

(62) Samuelson, Paul A. "The Pure Theory of Public Expenditures," Review of Economics and Statistics. November 1954, Vol. 36, pp 387-389.

(63) Schmandt, H. J., and G. R. Stevens. "Measuring Municipal Output," National Tax Journal. December 1960, Vol. 13(4), pp 369-375.

(64) Sloggett, Gordon R., and Daniel D. Badger. "Economics and Growth of Rural Water Systems in Oklahoma," Stillwater, Oklahoma: Oklahoma State University Experiment Station Bulletin B-176, August 1974.

(65) Steele, R., and A. M. Gray. "Statistical Cost Analysis: The Hospital Case," Applied Economics. 1982, No. 14, pp 491-502.

(66) Stevens, Barbara J. "Scale, Market Structure, and the Cost of Refuse Collection," The Review of Economics and Statistics. August 1978, Vol. 60(3), pp 438-448.

(67) Stinson, Thomas F., and Andrea Lubov. "Segmented Regression, Threshold Effects, and Police Expenditures in Small Cities," American Journal of Agricultural Economics. November 1982, Vol. 65(4), pp 738-746.

(68) Stocker, Frederick. "Research Needs and Opportunities Rural Community Facilities and Public Services." Paper prepared for Economic Development Division, Economic Research Service, U.S. Department of Agriculture, 1985.

(69) Tweeten, Luther. "New Policies to Take Advantage of Opportunities for Agricultural and Rural Development." Stillwater, Oklahoma. Professional paper of the Oklahoma Agricultural Experiment Station, 1985.

(70) U.S. Department of Agriculture. Rural Development Progress, January 1977-June 1979. Fifth Report of the Secretary of Agriculture to the Congress, Washington, D.C., 1979.

(71) U.S. Environmental Protection Agency. Small Wastewater Systems: Alternative Systems for Small Communities and Rural Areas. Office of Water Program Operators, Washington, D.C., July 1985.

(72) U.S. Senate Committee on Agriculture and Forestry. 1976 Revised Guide to the Rural Development Act of 1972. Washington, D.C.: U.S. Government Printing Office, 1976.

(73) Walzer, Norman. "Economies of Scale and Municipal Police Services: The Illinois Experience," The Review of Economics and Statistics. November 1972, Vol. 54(4), pp 431-438.

(74) Watt, P. A. "Economies of Scale in Schools: Some Evidence From the Private Sector," Applied Economics. 1980, Vol. 12, pp 235-242.

(75) Watts, Ann D., and Thomas M. Watts. "Minorities and Urban Crime: Are They the Cause or the Victims?" Urban Affairs Quarterly. June 1981, Vol. 16(4), pp 423-436.

(76) Weinblatt, J., Uriel Spiegel, Simon Hakim, and Uri Benziou. "Crime Prevention Policies and Externalities: A Theoretical Analysis," Public Finance. 1983, Vol. 38(1), pp 110-130.

(77) Will, Robert E. "Scaler Economies and Urban Service Requirements," Yale Economic Essays. Spring 1965, Vol. 5.

(78) White, Fred, and Luther Tweeten. "Internal Economies of Rural Elementary and Secondary Schooling," Socio-Economic Planning Sciences. 1973, 7(4), pp 353-369.

(79) Young, Dennis. How Shall We Collect We Collect the Garbage? Washington, D.C.: The Urban Institute, 1972.

*U.S. GOVERNMENT PRINTING OFFICE:1987-180-916:40317